A modified Langmuir Schaefer method for the creation of functional thin films

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Summary

Low-dimensional assemblies, where order and organization follow supramolecular principles, have shown remarkable importance due to their outstanding physical (photophysical, electrical) and/or chemical (catalysis, molecular separation) properties. An easy method to produce tailored functional materials with excellent level of control combines self-assembly and Langmuir-Schaefer deposition. This thesis illustrates how this new approach allows the deposition of graphene on a variety of substrates with a coverage that can be varied as desired from isolated sheets to a densely packed 2D arrangement. In contrast to the currently most common preparation protocols which rely on micromechanical cleavage, the yield of successful deposition of this approach is 100%, qualifying it as one of today's most trustworthy and promising methods.
The thesis also demonstrates how the same method allows to assemble hybrid materials based on single and/or multi-layers of clay platelets as building blocks. In this case clay nanosheets, deposited similarly to the graphene, act as 2D template for reaction or grafting of a variety of guest species (here C_{60}, Ni_8 molecular magnets, Prussian Blue analogues). Prefect layer-by-layer growth and control at the molecular level allow one to create entirely novel architectures whose final structure is encoded in the shape and properties of the clusters or molecules that are used. Interesting new properties emerge: for example 2 or 0D Prussian Blue analogue structures can be formed, which differently from 3D crystals, show new superparamagnetic-spin glass properties with high blocking glass temperature. Finally, this thesis demonstrates how the preparation method influences the morphology of organoclay assembly.

Samevatting

Laagdimensionale samenstellingen, waarin de orde en organisatie supramoleculaire principes volgen, hebben laten zien van opmerkelijke belang te zijn vanwege hun uitstekende fysische (fotofysische, elektrische) en/of chemische (katalyse, moleculaire scheiding) eigenschappen. Een eenvoudige methode voor de uitstekend gecontroleerde productie van op maat gemaakte functionele materialen combineert zelfassemblage en Langmuir-Schaefer depositie. Dit proefschrift laat zien hoe deze nieuwe aanpak de afzetting van grafeen mogelijk maakt op een verscheidenheid van substraten met een dekking die als gewenst kan worden gevarieerd, van geïsoleerde lagen tot een dicht opeengepakte 2D ordening. In tegenstelling tot de momenteel meest gebruikte bereidingsprotocollen, die gebaseerd zijn op micromechanische splitsing, is de opbrengst van succesvolle